A new species of Lemniscomys (Muridae) from Zambia

by

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ABSTRACT

A new species of *Lemniscomys, L. roseveari* **sp. nov.** is described and the status of the components of the *L. griselda* species-complex is examined by statistical analyses.

INTRODUCTION

During an overall revision of the species-group *Lemniscomys griselda* the author had the opportunity of examining an important series of a "single-striped grass mouse" collected in Balovale, Northern Rhodesia (now Zambia) by G. C. Shortridge and T. D. Carter in 1938.

The conclusion that this "grass mouse" belongs to an undescribed species was the result of an extensive statistical analysis, using canonical analysis and discriminant analysis (see Van der Straeten & Van der Straeten-Harrie, 1977, and Van der Straeten & Verheyen, 1978).

The author is very pleased to name the mouse *Lemniscomys roseveari* **sp. nov.** in honour of D. R. Rosevear whose book *The Rodents of West Africa* was a great stimulus and help when he started his studies on African Muridae.

A complete discussion of the *Lemniscomys griselda* species-group will be the subject of a later publication.

DESCRIPTION OF *LEMNISCOMYS ROSEVEARI* SP. NOV.

Measurements in mm of adult *Lemniscomys roseveari* sp. nov. are given in Table 1.

General colour of the back brownish, anteriorly more greyish, posteriorly more yellow-ochre, most like *L. linulus* from the Ivory Coast. Well defined black mid-dorsal stripe commencing between the ears. Back with pale-tipped hairs (buff or ochraceous-buff) forming small spots; the spots not forming a well defined pattern. More brownish than *L. rosalia* (cf. *sabulata*) and *L. griselda* but a little paler than *L. rosalia* (cf. *spinalis*). Ears and feet with yellow-ochre hairs. The hairs of the underside are pure white; underside edged with a buff line. Tail longer than head and body, about 110% of the head and body length, dark above, ochraceous-orange or yellow-ochre laterally and white below. Mammary formula 2(2-2). Skull large with a broad M^1, supra orbital ridges well developed. Upper incisors mostly with faint grooves. Some specimens have a small Sm in $M_{\overline{1}}$. The skull measurements of males and females show only small differences. The skull measurements, PAL, UPDE, M^1, BUL and BRCA are highly significantly larger (= 1% significance level) than, DIN and ROB are significantly larger (= 5% significance level) than, and PAF is highly significantly smaller than for the other members of the East and South African *Lemniscomys griselda* species-complex (see discriminant analysis). The hindfoot is significantly longer in males than in females.

TABLE 1.

Measurements in mm of adult *Lemniscomys roseveari*. Number of specimens measured, mean, range and standard deviation are given from left to right for each of the measurements. For the exact description of the skull-measurements see Van der Straeten & Van der Straeten-Harrie (1977).
The external measurements are those shown on the museum labels.

Variable code	Description	Holotype	*Lemniscomys roseveari* ♂♂	*Lemniscomys roseveari* ♀♀
HB	Head and body length	137,0	15; 123,7 (113,0 –137,0) 6,4	11; 125,7 (118,0 –137,0) 5,7
TL	Length of tail	147,0	14; 137,3 (123,0 –151,0) 8,7	11; 138,7 (129,0 –153,0) 7,2
HL	Length of hind foot	28,25	15; 28,3 (26,5 – 29,5) 0,7	11; 27,2 (26,0 – 28,5) 0,9
EL	Length of ear	17,0	15; 16,4 (16,0 – 18,0) 0,6	11; 16,2 (13,0 – 19,0) 1,4
GRLE	Greatest length of skull	33,90	17; 32,18 (30,65– 33,90) 0,88	11; 32,22 (30,80– 33,90) 1,07
PRCO	Prosthion-condylion	31,20	17; 29,54 (27,85– 31,00) 0,79	11; 29,45 (27,95– 31,20) 1,03
HEBA	Henselion-basion	26,35	17; 25,03 (23,55– 26,35) 0,69	11; 24,91 (23,65– 26,35) 0,89
HEPA	Henselion-palation	14,00	17; 13,50 (12,65– 14,40) 0,45	11; 13,45 (12,80– 14,15) 0,41
PAF	Length of palatal foramina	6,35	17; 5,92 (5,55– 6,45) 0,28	11; 5,89 (5,25– 6,35) 0,27
DIA1	Length of diastema	8,40	17; 7,55 (6,80– 8,10) 0,30	11; 7,66 (6,95– 8,40) 0,43
DIA2	Distance between the anterior border of the alveole of M^1 and the edge of upper incisor	8,90	17; 8,17 (7,40– 8,60) 0,31	11; 8,33 (7,75– 8,95) 0,43
INT	Interorbital breadth	4,70	17; 4,75 (4,50– 4,90) 0,13	11; 4,70 (4,15– 4,95) 0,24
ZYG	Zygomatic breadth on the zygomatic process of the squamosum	15,25	17; 15,16 (14,35– 15,80) 0,42	11; 15,29 (14,55– 16,25) 0,53
PAL	Palate breadth between M^1	2,65	17; 2,49 (2,20– 2,85) 0,15	11; 2,55 (2,10– 3,00) 0,27
UPTE	Length of upper cheekteeth	6,05	17; 6,09 (5,75– 6,40) 0,19	11; 6,06 (5,70– 6,35) 0,22
UPDE	Breadth of upper dental arch	7,20	17; 6,78 (6,50– 7,00) 0,15	11; 6,90 (6,50– 7,35) 0,28
M^1	Breadth of M^1	2,20	17; 2,12 (2,05– 2,20) 0,06	11; 2,11 (2,00– 2,20) 0,06
ZYPL	Breadth of zygomatic plate	4,65	17; 4,23 (3,80– 4,65) 0,24	11; 4,22 (3,90– 4,65) 0,22
BNAS	Greatest breadth of nasals	3,70	17; 3,61 (3,35– 3,90) 0,16	11; 3,59 (3,35– 4,05) 0,24
LNAS	Greatest length of nasals	13,35	17; 12,38 (11,30– 13,40) 0,55	11; 12,51 (11,45– 13,40) 0,67
LOTE	Length of lower cheekteeth	5,75	17; 5,80 (5,55– 6,10) 0,18	11; 5,84 (5,35– 6,05) 0,20
CHOA	Breadth of choanae	1,55	17; 1,47 (1,25– 1,80) 0,15	11; 1,60 (1,40– 1,75) 0,11
BUL	Length of auditory bulla	6,50	17; 6,17 (5,80– 6,55) 0,23	11; 6,04 (5,80– 6,60) 0,27
BRCA	Braincase breadth	13,45	17; 13,24 (12,70– 13,70) 0,29	11; 13,37 (12,85– 14,00) 0,35
DIN	Depth of incisors	1,85	17; 1,73 (1,50– 1,90) 0,12	11; 1,74 (1,50– 1,90) 0,14
ROH	Rostrum height at anterior border of zygomatic plate	8,40	17; 8,29 (7,50– 9,00) 0,33	11; 8,24 (7,60– 8,85) 0,40
ROB	Rostrum breadth at anterior border of zygomatic plate	6,15	16; 5,91 (5,50– 6,35) 0,22	9; 5,95 (5,65– 6,40) 0,25
PCPA	Distance between the extreme points of processus condylicus and processus angularis	11,40	15; 10,84 (10,15– 11,45) 0,33	8; 10,91 (9,70– 11,50) 0,60

Specimens examined

Holotype: adult ♀, age-class 3, skin and skull, RG. No. 6396, from Balovale, Zambia, 1 015 metres, obtained 27 September 1938 by G. C. Shortridge and T. D. Carter during the Vernay-Kaffrarian Museum Zambesi Expedition. Type specimen in the collections of the Kaffrarian Museum, King William's Town, Republic of South Africa.

Paratypes: 8 specimens. Kaffrarian Museum, RG. No. 6353, ♀, age-class 6, 19/8/1938; RG. No. 6355, ♂, age-class 2, 20/8/1938; RG. No. 6356, ♂, age-class 3, 21/8/1938; RG. No. 6360, ♂, age-class 3, 22/8/1938; RG. No. 6373, ♀, age-class 5, 4/9/1938; RG. No. 6387, ♂, age-class 3, 17/9/1938; R.G. No. 6391, ♂, age-class 4, 25/9/1938; British Museum Natural History, RG. No. 49.354, ♂, age-class 5, 1/9/1938.

All specimens from Balovale, Zambia, with skin and skull, collected by G. C. Shortridge and T. D. Carter.

For details concerning age-classes see Van der Straeten (1979).

Other material examined: 28 specimens. Kaffrarian Museum, RG. Nos.: 6352, 6369, 6377, 6378, 6381, 6385, 6386, 6389, 6394, 6397, 6402, 6404, 6415, 6416, 6418, 6420 (all ♂♂, all from Balovale); 6358, 6361, 6362, 6370, 6374, 6383, 6392, 6395, 6412, 6417 (all ♀♀, all from Balovale); British Museum Natural History, RG. No. 1937.1.4.108, ♀, from Balovale; RG. No. 55.1164, ♀, from Solwezi.

DISTRIBUTION

Lemniscomys roseveari sp. nov. at the present time is known only from two localities in Zambia: Balovale (13° 33'S, 23°07'E) and Solwezi (12° 10'S, 26° 24'E).

STATISTICAL ANALYSES

Canonical analysis.

For the canonical analysis 179 specimens from East and South Africa were used. These were divided into eight groups as indicated in Table 2. The specific names used in Table 2 for the different forms of the *Lemniscomys griselda* species-group are based upon a biometrical revision of this species group.

TABLE 2.

Grouping of 179 specimens of *Lemniscomys* from East and South Africa for purposes of canonical analysis.

Group No.	Species	Number of specimens
1	*Lemniscomys roseveari*	28
2	*Lemniscomys rosalia* (cf. *spinalis-zuluensis-sabiensis*) ♂♂	34
3	*Lemniscomys rosalia* (cf. *spinalis-zuluensis-sabiensis*) ♀♀	45
4	*Lemniscomys rosalia* (cf. *calidior*)	23
5	*Lemniscomys griselda*	18
6	*Lemniscomys rosalia* (cf. *sabulata*)	14
7	*Lemniscomys rosalia* (cf. *rosalia*)	8
8	*Lemniscomys rosalia* (cf. *macculosus-phaeotis*)	9

The analysis is based upon 18 skull measurements (see Table 3). There are seven canonical variates, only five of which are significantly different from zero. In Table 4 are given the eigenvalues of the canonical transformation and the importance of the different canonical variates. In Table 3 are given the eigenvectors of the 18 variables for the first three canonical variates. Using these eigenvectors a diagram was drawn. For each group the centre and the most extreme values of each cluster of points are indicated. Fig. 1 shows the graphical representation of the first and second canonical variates. The other canonical variates are not illustrated as they give no further information concerning the problem.

TABLE 3.

Eigenvectors of 18 variables for the first three canonical variates.

Variable code	1	2	3
GRLE	− 0,8632	0,5884	− 0,9461
PRCO	2,5536	− 1,9409	1,7076
HEBA	− 2,3949	1,7373	− 1,8240
HEPA	− 0,2616	− 0,0931	− 0,0034
PAF	− 2,3517	0,3968	0,8509
DIA1	− 1,6253	− 0,3303	2,6270
DIA2	2,9291	− 0,5666	− 0,6978
INT	0,9013	− 1,6658	0,2164
ZYG	0,0128	1,1459	1,7343
UPTE	− 1,6967	0,0369	1,1756
UPDE	0,7826	− 0,0420	− 2,9892
M1	4,6652	10,2576	3,9417
ZYPL	0,5395	− 0,3966	− 0,0048
BNAS	1,1364	0,2550	− 0,9504
LNAS	0,3861	− 0,1074	0,4877
LOTE	− 0,1950	− 0,0873	− 0,2200
BUL	0,3856	0,3351	− 0,1951
BRCA	0,5189	0,0111	− 0,7968

TABLE 4.

Eigenvalues of the canonical transformation with test of significance.

No.	Eigenvalue	Relative (%) importance	Chi-square	Degrees of freedom	Probability
1	47,455	41,5	518,568	126	1,000
2	27,952	24,5	339,170	102	1,000
3	19,147	16,8	212,575	80	1,000
4	11,091	9,7	116,624	60	0,999
5	4,039	3,5	54,643	42	0,910
6	3,203	2,8	29,348	26	0,705
7	1,366	1,2	8,987	12	0,295

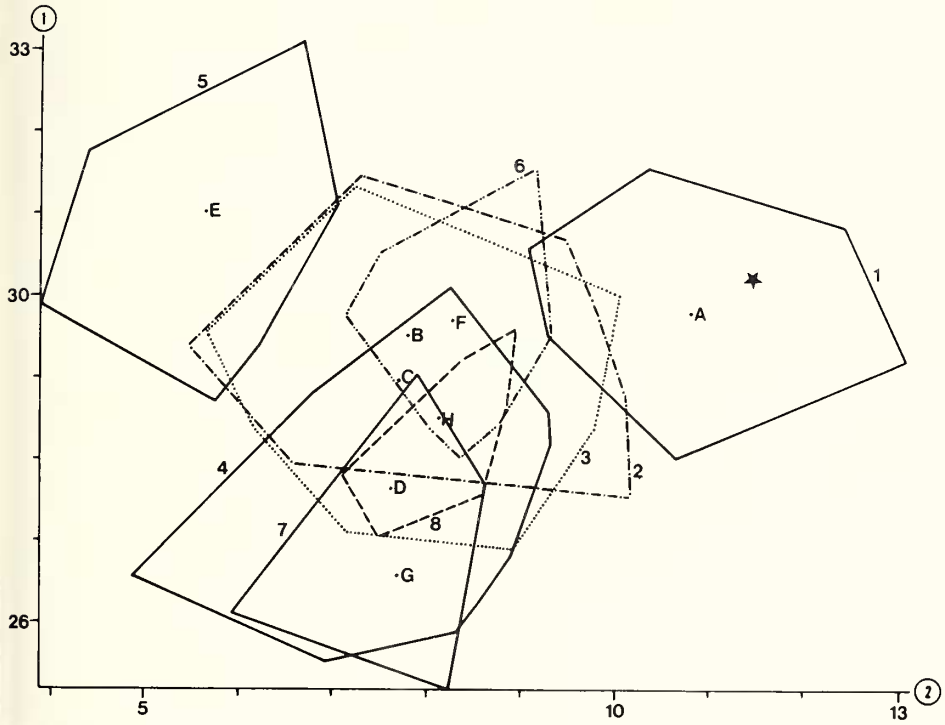

Fig. 1. Canonical analysis: canonical means (solid circles) and extreme limit of each cluster of points; canonical variates: 1 (abscis) and 2 (ordinate); 1, A: *Lemniscomys roseveari*; 2, B: *L. rosalia* (cf. *Spinalis*) ♂♂; 3, C: *L. rosalia* (cf. *spinalis*) ♀♀; 4, D: *L. rosalia* (cf. *calidior*); 5, E: *L. griselda*; 6, F: *L. rosalia* (cf. *sabulata*); 7, G: *L. rosalia* (cf. *rosalia*); 8, H: *L. rosalia* (cf. *macculosus*); black star: type of *L. roseveari*.

Considering the first canonical variate there are distinguishable three groups within the East and South African *Lemniscomys griselda* species-complex: 1. *L. griselda*, 2. *L. rosalia* (with different subspecies separated by the second and third canonical variates) and 3. *L. roseveari*. The overlap between the three groups is very small. Each of these groups is considered here as corresponding with a valid species.

Discriminant analysis and dendrogram.

The same groups and specimens were used as for the canonical analysis with the addition, however, of a group of 113 specimens of *Lemniscomys linulus* (see Van der Straeten, 1979). Out of the 18 measurements used for the canonical analysis 11 were selected for the present analysis: GRLE, PRCO, HEBA, PAF, DIA2, INT, ZYG, UPTE, UPDE, M^1 and BUL. All groups were combined in a two by two groups discriminant analysis in order to determine the generalized distances of Mahalanobis (D^2_M) and the probability of misclassification. The results are summarized in Table 5.

To illustrate the biometrical affinities a dendrogram was drawn up (Fig. 2) based on the matrix of D^2_M values and generated by the U.P.G.M.A. clustering method (see Sneath & Sokal, 1973).

The results of this dendrogram and those of the canonical analysis are almost the same. The West African *Lemniscomys linulus* is quite different from the East and South African species of the *Lemniscomys griselda* species-group. There is a very close relationship between *Lemniscomys rosalia* (cf. *spinalis*) (=spin in Fig. 2), *L. rosalia* (cf. *subulata)* (= sab), *L. rosalia* (cf. *calidior*) (= cal), *L. rosalia* (cf. *rosalia*) (= rosa) and *L. rosalia* (cf. *macculosus*) (= phae) which are considered to belong to the same species namely *Lemniscomys rosalia*. Further study of more material is needed, however. The biometrical distance between *Lemniscomys rosalia*, *L. griselda* and *L. roseveari* is important enough to consider these three forms as valid species.

TABLE 5.

Matrix of generalized distances of Mahalanobis (= D^2_M) (lower triangle) and probability of misclassification (%) using a 11 variate discriminant function (upper triangle) (abbreviations see Fig. 2).

Species No. Specimens	lin 113	ros 28	spin 79	cal 23	gris 18	sab 14	rosa 8	phae 9
lin	—	0,00	0,01	0,19	0,00	0,00	0,08	0,00
ros	90,0530	—	6,08	2,38	0,21	4,78	0,40	0,17
spin	53,7478	9,5844	—	18,42	5,13	30,25	2,71	13,82
cal	33,4167	15,6836	3,2364	—	1,25	8,37	14,74	5,97
gris	85,6822	32,6681	10,6644	20,0785	—	2,68	0,19	0,37
sab	85,5641	11,1154	1,0702	7,6221	14,9091	—	3,43	1,30
rosa	40,1762	28,2083	14,8163	4,3912	33,3432	13,2701	—	0,89
phae	56,6743	34,1637	4,7392	9,6963	28,6237	19,8033	22,4351	—

In order to eliminate errors as much as possible, two discriminant functions using skull measurements were elaborated. The first discriminant function makes it possible to differentiate between *Lemniscomys roseveari* and the species of the *L. griselda* species-group from East and South Africa.

$K = -3{,}454 \times PAF + 3{,}543 \times DIA\ 2 - 5{,}417 \times UPTE + 5{,}950 \times UPDE + 20{,}819 \times M^1 - 26{,}96$

If K>O then the specimen is a *Lemniscomys roseveari*; if K<O it is a species of the *L. griselda* species-group. The chance of an erroneous determination is 6,8%. In the material examined two *Lemniscomys roseveari* and eight *L. rosalia* (from the Transvaal and Namibia) were misidentified with this function. If the eighteen available factors are used for a discriminant function, this percentage drops to 4,9.

The second discriminant function, using three factors, makes it possible to differentiate *Lemniscomys roseveari* from the adjacent *L. griselda*. It gives a 1,9% chance of an erroneous determination.

$K = 14{,}074 \times PRCO - 14{,}581 \times HEBA - 10{,}880 \times PAF + 21{,}85$

Specimens of *Lemniscomys griselda* give negative values for K whereas specimens of *L. roseveari* give positive ones.

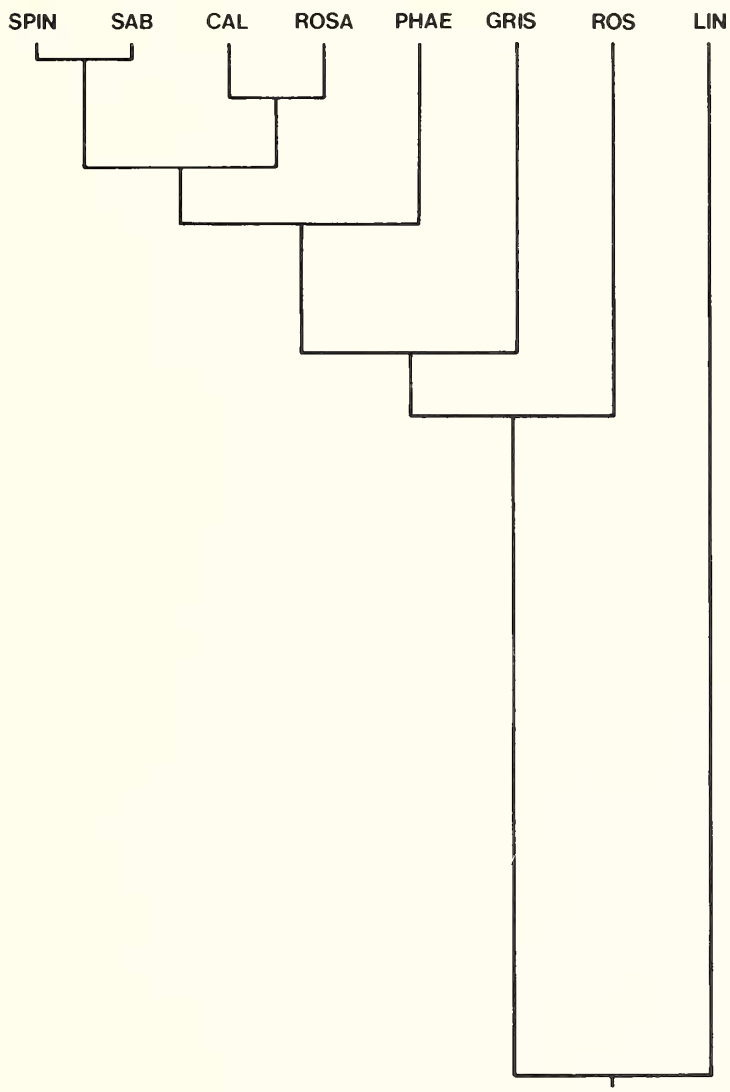

Fig. 2. Dendrogram, based on a matrix of generalized distances of Mahalanobis, generated by the U.P.G.M.A. clustering methods; spin: *Lemniscomys rosalia* (cf. *spinalis*), sab: *L. rosalia* (cf. *sabulata*), cal: *L. rosalia* (cf. *calidior*), rosa: *L. rosalia* (cf. *rosalia*), phae: *L. rosalia* (cf. *macculosus*), gris: *L. griselda*, ros: *L. roseveari*, lin: *L. linulus*.

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